

## **Reorganisation of Wood Production for Improved Performance: a Swiss Forest District Case Study**

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An extremely fragmented timber supply, high harvesting costs, low profitability, high subsidies and insufficient competitiveness characterise forest enterprises in Switzerland. In a case study using a forest district in the state of Solothurn as an example, it was sought to identify strengths and weaknesses of wood production and to formulate possible improvement opportunities. The results indicate that there is considerable potential for industry rationalisation. The greatest handicaps are the small sized forest holdings, excessive numbers of staff, insufficient use of modern harvesting technology and costly business administration. The most eminent of the proposed improvement measures are those which aim to increase concentration of timber supplies and reduce production costs. These include greater centralising of timber sales as well as planning and steering of production, making full use of modern harvesting systems, reducing transaction costs, supporting administration, planning and steering of wood production with modern information technology and reducing input on stand tending. In principle, amelioration can be best achieved by close cooperation with neighbours or even merger of enterprises. Consequently, there is a need for related business tasks to be combined in functions. The paramount prerequisite for success is the willingness and readiness of all affected stakeholders to make changes. The situation described is typical for Swiss forestry and the proposed solutions could well be used as models for a wide range of Swiss forest districts.

**Keywords:** forest enterprise, business process reengineering, Switzerland, organisational models

### **INTRODUCTION**

Forests in Switzerland cover 31% of the total land area and are therefore an important element of land use. Only farmland holds a larger share (37%), in contrast to unproductive wasteland (21%), industrial/residential/infrastructural zones (7%) and lakes and rivers (4%) (BUWAL 2003). Publicly owned forests amount to 73% shared by 3,700 owners, with an average public forest holding of 270 ha. The Swiss Federation owns less than 1% and the states hold less than 5%, whereas communities, cities and corporations under public law are the most important

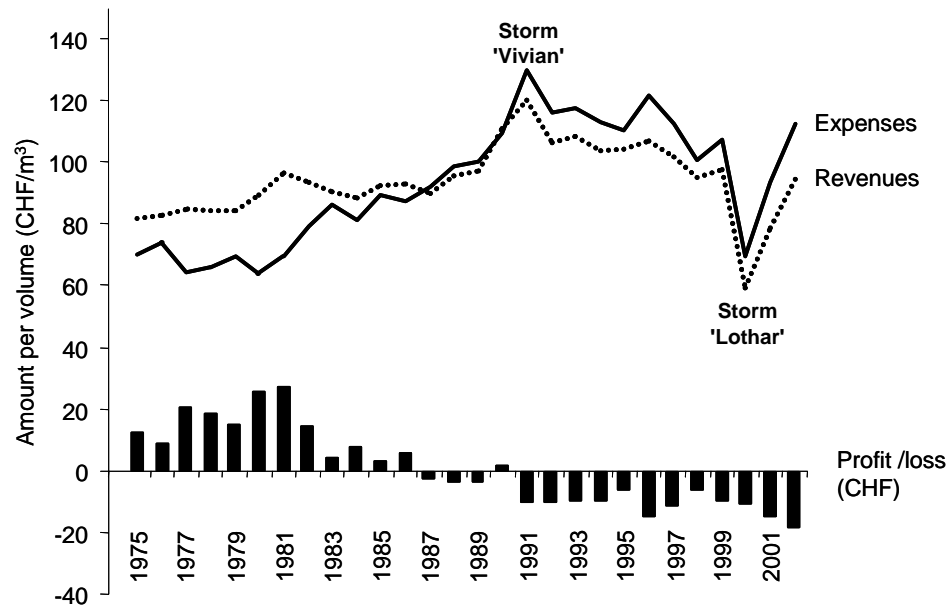
owners, accounting for 67%. Private holdings (27%) are even more fragmented and average only 1.3 ha per owner (BUWAL 2003). In the majority of cases Swiss forest enterprises are business units of one or more public forest owners. As an important difference to the situation in other countries normally forest owners do not operate timber milling facilities. Table 1 gives an overview of the Swiss forest ownership types and forest enterprises.

**Table 1.** Numbers and areas of Swiss forest ownership types

Ownership type	Number of units	Number of enterprises	Aggregate forest area (ha)
Swiss Federation	1	97	9,134
Federal State (Kanton)	26	128	56,035
Forest Districts	148	-	-
Forest Ranges	ca. 1,100	-	-
Public Forest Owners	3,673	2,705	821,826
Private Public Owners	245,975	-	331,905
Total	-	2,930	1,218,900

Source: BUWAL (2003).

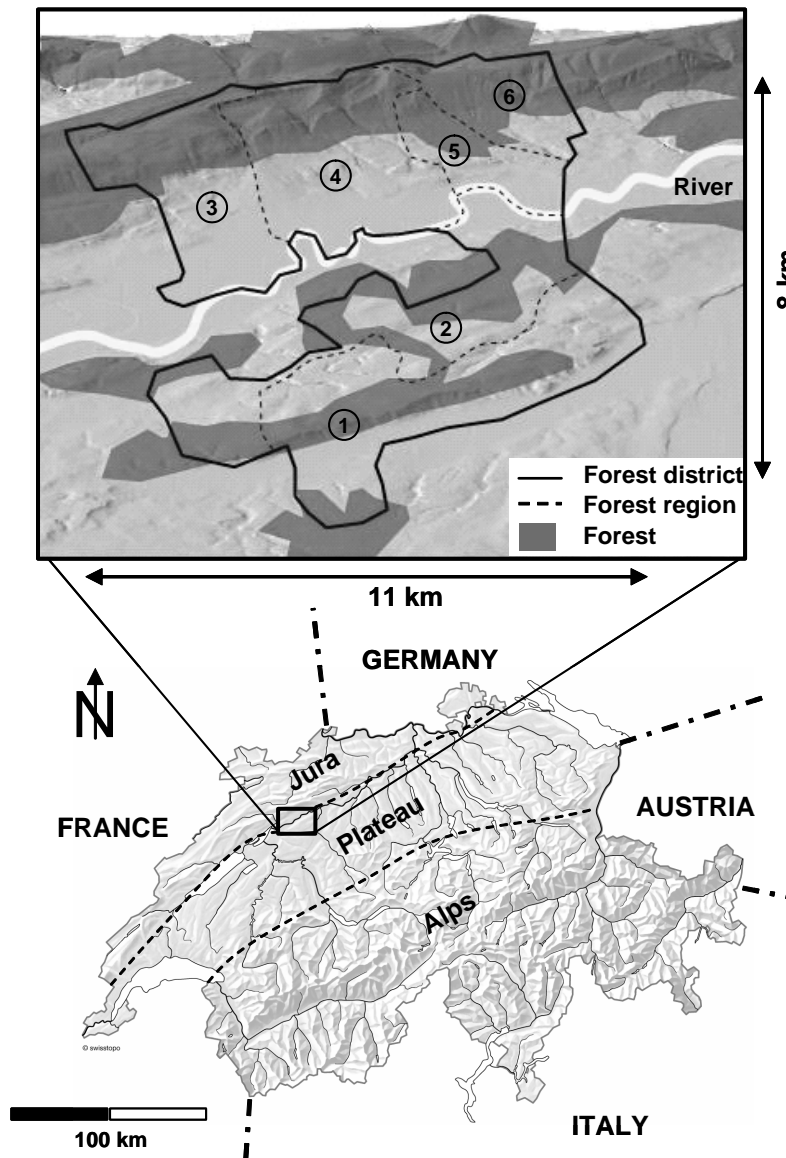
This ownership structure greatly complicates competitive forest management. Furthermore, forest managers face the problem of rising production costs and declining sales revenues. Operating results make it increasingly difficult to fulfil the multifunctional requirements on the forests: prevention of avalanches and landslides or blocking of falling rocks, habitat protection of endangered animals and plants, stimulation of biodiversity and enhancement of recreational benefits (Seidl *et al.* 2002). Recently, various interest groups have become increasingly emphatic on their specific demands thus confronting the forest managers with accentuating and conflicting claims (e.g. habitat protection versus recreational activities or hunting versus orienteering). This development further reduces managerial freedom and raises production costs. Previously, timber production generated sufficient profit to finance prevention of natural hazards and provision of ecological and social benefits. Reasonable revenues and well stocked public treasuries kept most forest enterprises afloat. When the economic situation became tighter, the public authorities (communities, states and federation) often could be prompted to compensate growers for costs of the additional services. But today public treasurers are faced with dwindling monetary resources and become increasingly reluctant to contribute to the extra costs caused by these additional constraints. Figure 2 shows that the economic base of the enterprises is slowly eroding even though average performance in harvesting had been raised by about one third over the last 20 years. Furthermore, the former sellers' market has transformed into a buyers' market, compelling foresters to align timber production with their customers' needs rather than with purely silvicultural requirements. Swiss forest enterprises may survive only if they reorganise their operations to reduce costs.



**Figure 1.** Management ratios of Swiss forest enterprises  
Source: BUWAL (2003).

Due to the small size of the average forest holding, corrective measures in individual enterprises only may not restore profitability. Measures designed to overcome structural weaknesses of the Swiss forestry and timber industry, identified nearly 30 years ago (Steinlin *et al.* 1975), seem to be much more promising. In the last decade, Swiss forests have been hit by two extreme storms (Vivian and Lothar), which not only brought down large quantities of timber but also depressed timber prices to ruinous levels (WSL and BUWAL 2001) (Figure 1). Subsequent bark beetle infestations kept timber supplies very high for several years thus preventing a recovery of markets and prices. Both events accelerated internationalisation of continental European timber markets. Today, international competition in timber trade and scarce public funds increase pressure on many forest enterprises in Switzerland. If profitability is to be restored, the structure of forest holdings must be changed. For those who are affected by this change, consequences may be severe.

Against this background, the state forest service of Solothurn commissioned the Forest Use Management section of the Swiss Federal Institute for Forest, Snow and Landscape Research (WSL) to carry out a reengineering study. The study aimed to analyse the wood production chain in six forest enterprises of the forest district Bucheggberg / Lebern West, which served as the object of the case study (Figure 2). It was undertaken with the close cooperation of a selection of involved local and regional parties. The situation described is typical for a large portion of Swiss forest enterprises and the approaches elaborated could be applicable to other areas and can set further initiatives.



**Figure 2.** Location of the forest district Bucheggberg / Lebern West and forest regions

## METHODS AND PROCEDURES

Methodologically the study is primarily based on the principles of 'Systems Engineering' (Haberfellner 1999), the concepts of 'Business Process Reengineering' (Hammer and Champy 1993) and 'Man, Technics and Organisation' (Strohm und Ulich 1997). Forest enterprises are systems in which 'Man' and 'Technics' interact. Due to the complexity of these so-called socio-technical systems they cannot be

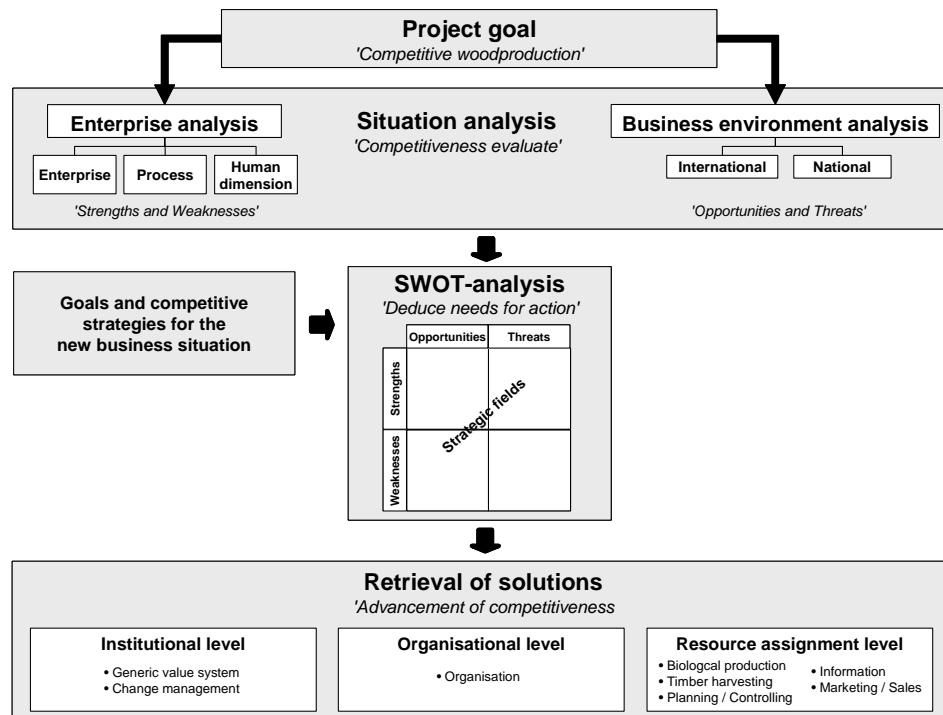
perceived as whole entities. Therefore, it is necessary to view them under various aspects (Specker 2001). The investigations were focused on wood production including biological production, harvesting, transport and even timber processing. All partners of the timber chain – including forest owners, forest managers, the state forest service, harvesting contractors and timber customers – were incorporated in the study. Information was obtained through structured interviews, various workshops, examination of business documents (e.g. accounting reports) and literature searches.

Figure 3 shows schematically the procedure of the study. Aiming for the project goal to organise wood production in a more competitive manner, the overall situation was analysed in the *first phase*. This analysis included the six forest enterprises and their general business environment. For the enterprise analysis, information was collected on the enterprises ('enterprise'), on the business processes ('process') and on the involved parties ('the human dimension'). This information was evaluated to reveal their weaknesses and strengths as well as their position in respect to competitiveness. Analysis of the business environment demonstrated national and international trends, forming the base to identify advantageous opportunities and threats to be avoided.

During the *second phase*, solutions were searched for, which would help the enterprises to produce and market timber profitably again. The forest enterprises in question are complex and diverse entities. In the course of the situation analysis, these properties made it rather difficult to identify the most promising direction of impact and method of resolution. The method of the SWOT (strengths, weaknesses, opportunities and threats) analysis (Lombriser and Abplanalp 1997) served as a hinge between the situation analysis and the retrieval of solutions. Crucial problems and fields of action can be enumerated by confronting strengths and weaknesses with opportunities and threats. Thus four different alternative strategies are formulated, namely:

- Use strengths to profit from arising opportunities;
- Use strengths to avert possible threats;
- Reduce weaknesses to fend off imminent threats; or
- Reduce weaknesses to profit from new opportunities.

Within these four strategies, logic and suggestive SWOT combinations are systematically searched for. Important guidelines for this step were the fundamental goals and competitive strategies defined by the forestry parties in respect to new business situations. On the basis of these broadly formulated goals of the forest enterprise, individual strengths/weaknesses and opportunities/threats have been balanced against each other. The resulting actions are bundled in the four corresponding strategic fields (Figure 3). The elaborated fields of actions were allocated following the concept of the 'New Institutional Economics' (Williamson 2000) to three levels of actions: the 'Institutional level', the 'Organisational level' and the 'Resource assignment level'.



**Figure 3.** Procedure in the reengineering study

## SITUATION ANALYSIS

Because the present situation had been analysed from the viewpoints of 'international business environment', 'national business environment', 'enterprise', 'business process' and 'the human dimension', it was possible to make the complex interactions between forest owners, customers, neighbours and contractors tangible.

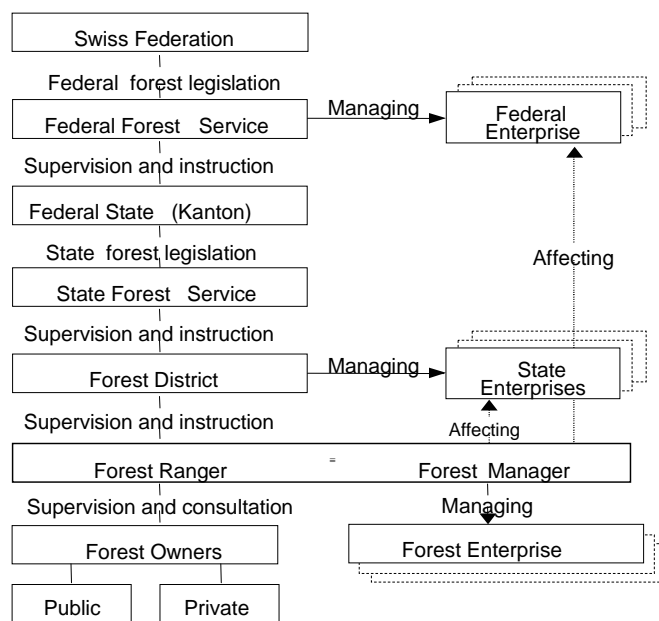
### Characteristics of the Business Environment

The main topics of analysis of the business environment were international and national trends as well as their impacts on Swiss forest enterprises.

#### *Features of Swiss forestry organisation*

In that the majority of the forest area in Switzerland is owned by the public (predominantly by townships and cities), public organisation has an important bearing on any reengineering project (Figure 4). The Swiss Federation is the highest authority in forestry but owns virtually no forests. Through legislation and ordinances it defines a statutory framework of management guidelines and actions of promotion. Most of the power of control and direction is delegated to the 26 states, which have far-reaching powers of self-government. They draw up the forest organisation to enforce federal and state forest acts and support the forest enterprises with aid projects (e.g. truck roads, reforestation). For this purpose they define a number of forest districts headed by a public forestry officer who not only acts as

public administrator with supervisory powers but also as a consultant of the forest owners. Forest districts are subdivided into forest ranges headed by forester rangers. In the majority of the 26 states, as in Solothurn, they fulfil a dual function: firstly the forester is the manager of the forest enterprises in his range and secondly he is an official authority of the state. Normally he is employed by one or several public forest owners. His official work for the state is remunerated on a time basis. In principle, forest enterprises are widely independent, but in reality they are managed to safeguard the public interest rather than owners' interests. The fact that in Swiss forestry ecological aspects receive far more attention and emphasis than economic ones, does not promote entrepreneurial thoughts and skills.



**Figure 4.** Structure of Swiss forest organisation

#### *Prevalent international trends*

Because of growing international competition, organisational structures and business procedures of international forest and timber industries are undergoing striking changes. Particularly abroad, enterprises of the timber industry react with drastic rationalisation measures. They strive for cost reduction through economies of size, e.g. by amalgamation or by putting up new large milling plants with capacities of several hundred thousand cubic metres per annum. Simultaneously, they seek to secure supply by new logistical schemes. New quasi-monopoly supply structures and highly efficient operations of timber supply emerge through these concentration processes. These trends are widely absent in Switzerland.

*Domestic peculiarities of timber production*

In comparison to other European countries the Swiss timber production can be characterised by:

- a very high growing stock (Switzerland 354 m<sup>3</sup>/ha; Austria: 266 m<sup>3</sup>/ha; Germany: 271 m<sup>3</sup>/ha; France: 116 m<sup>3</sup>/ha; Italy: 109 m<sup>3</sup>/ha); the main species by growing stock are spruce 48%, fir 15% and beech 17% (BUWAL 2003);
- a harvest of only about two thirds of the annual increment of growth (6.7 m<sup>3</sup>/ha/year out of 9.2 m<sup>3</sup>/ha/yr) (BUWAL 2003);
- an increasing number of stands is exceeding their optimal age – which increases the volume of difficult-to-sell lumber grades (softwoods with large diameters);
- an extremely fractured timber supply and stagnating or declining timber prices;
- with the exception of the alpine areas, forests generally well opened up by transport networks (permanent truck roads 26.2 m/ha, machine and snigging trails);
- an oversized workforce (7.5 man-year/ha), suboptimal harvesting techniques and unfavourable ownership structures, causing high production costs; there is considerable potential for rationalisation, particularly with respect to harvesting and transport arrangements;
- very small or even negative stumpage revenue: Switzerland: 24 EUR/m<sup>3</sup>; Austria: 60 EUR/m<sup>3</sup>; Germany: 45 EUR/m<sup>3</sup> (Jaakko Pöyry Consulting 2003);
- substantial subsidies and a highly traditional corporate culture, which hinders entrepreneurial behaviour;
- challenge to forest management by all beneficiaries, each claiming their individual needs;
- forest business management exceedingly influenced by public forest services; and
- in general, enterprises of the Swiss forest and timber industry with weak international competitiveness.

These characteristics give rise to a number of risks but also opportunities for Swiss forest enterprises. Inevitably, forest enterprises have to be repositioned within these powerful trends. If an enterprise opts primarily for timber production, it must be able to compete on the international markets.

Favourable circumstances were classified as opportunities such as:

- timber is a renewable and CO<sub>2</sub>-neutral raw material;
- in the future timber will be harvested increasingly with modern, cost-saving technologies;
- modern information technologies offer foresters a wide range of management tools to make better decisions; and
- many actors of the timber supply chain take a keen interest in major changes and signal ready support for their adoption.



Threats stem from:

- decreasing profitability of wood production;
- decreasing competitiveness;
- loss of autonomy; and
- scarcity of public means (finance).

The scarcity of public finance for instance warns that in the future public aid might decline such that only those forest enterprises that actively participate in the process of change will survive. Furthermore, the threat analysis indicates that a wait-and-see attitude and adherence to traditional structures might have a negative impact on Swiss forestry and might jeopardise the principle of a comprehensive sustainability. If sustainability – especially economic sustainability – is to be maintained or restored, immediate steps need to be taken

### **Analysis of the Forest Enterprises**

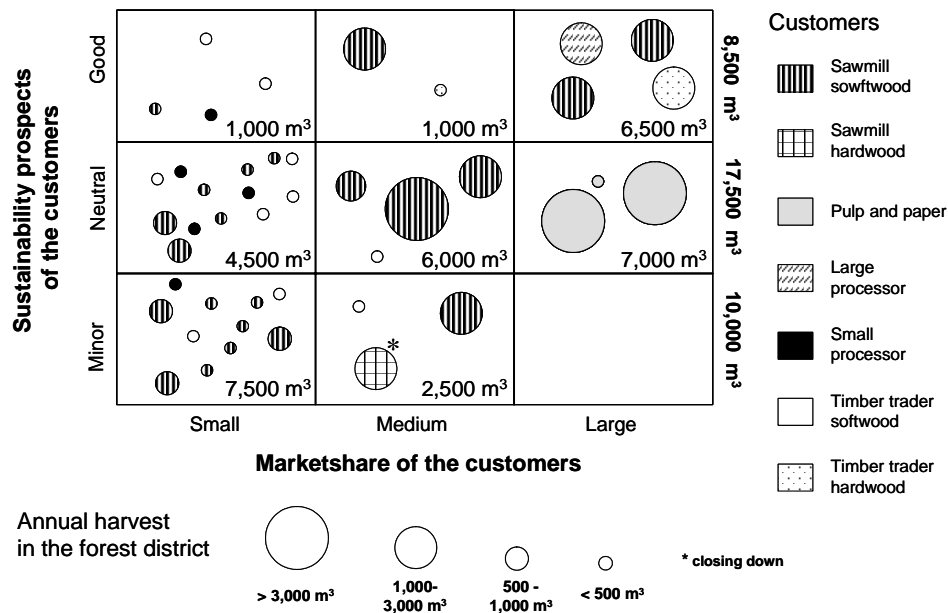
In order to recognise strengths and weaknesses, the analysis was focused on the three domains: enterprises, business processes and the human dimension.

#### *Characteristics of the enterprises*

In respect to individual forest enterprises, the main aspects which are of interest include general conditions of wood production, infrastructure, organisation, business goals, profitability and relationship to the business environment. The strengths and weaknesses can be summarised as follows:

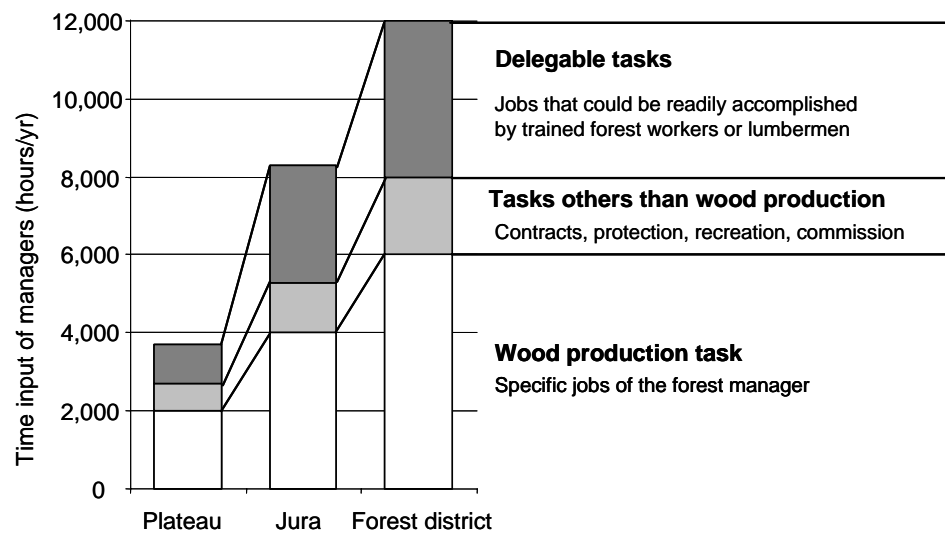
- Two of the six enterprises are situated on the Plateau (lowland between the Alps and the Jura Mountains). Four enterprises lie in the Jura Mountains (Figure 2). Favourable conditions of production, such as excellent situation in the middle of the main outlet area, prevail in all enterprises.
- The majority of the important timber industries lie within a range of 80 km from the forest sites, including four pulp and paper mills, one particle board manufacturer with two plants and eight large sawmills, not to mention the more than 150 small to medium sized mills. Furthermore, close to half the Swiss population lives within the same perimeter.
- Small size of the forest holdings and the resulting complex organisations are the greatest handicaps. Without explicitly formulated business goals it is very difficult to realise a goal-oriented management, to select promising strategies and to carry out an efficient control.
- Having a large number of product lines causes high sales costs and reduces returns on timber sales, the main source of income of the enterprises. Although a wide product range enables maximisation of gross proceeds, it calls for a large clientele and consequently for high expenses (e.g. for customer care and preparation and sales).
- When planning timber harvesting, the enterprises' own resources are often given more consideration than customers' requirements. In spite of the change from a sellers' market to a buyers' market, customers' needs still do not receive adequate attention and the selection of customers follows rather casual lines. Figure 5 reveals that the portion of the timber sold to customers with

minor prospects of sustainability is larger than that to customers of considerable importance and sound prospects. The enterprises split their sales volume of about 35,000 m<sup>3</sup> amongst 44 major customers. Approximately 70% of the supply is purchased by only 13 customers. The remainder is parcelled up in small lots and sold to a multitude of small processors.

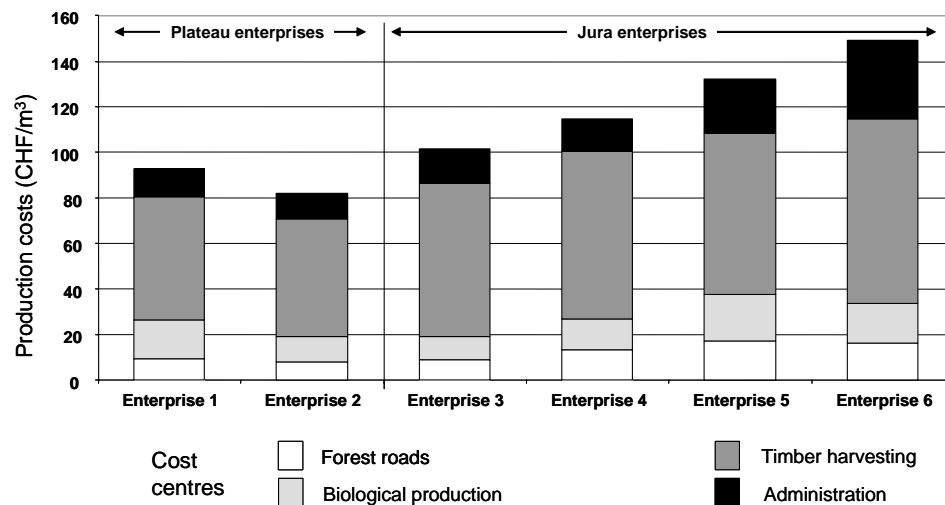


**Figure 5.** Portfolio of wood customers and wood products

- Regional forest contractors offer a substantial range of high quality services. Yet, due to the comparatively large numbers of their own staff the foresters cannot make full use of these services, and instead carry out many tasks with their own resources using suboptimal work methods and multipurpose equipment. The enterprises rarely coordinate their employment of contractors. Coordination would increase the size of the individual logging area and substantially reduce costs for the translocation of staff and equipment.
- The administrative sectors of all enterprises lack the support of specialised forestry software and expertise. All foresters spend considerable time carrying out tasks that could easily be delegated to staff of lower qualifications and pay. Figure 6 shows that the six managers spend 4,000 hours a year on jobs for which they are overqualified.
- Wood production as a whole is still too costly and indicates considerable rationalisation potential, although many enterprises have markedly reduced costs of log production and in timber harvesting (Figure 7).



**Figure 6.** Workload composition of the forest managers in the study area



**Figure 7.** Mean costs in wood production in the considered forest enterprises

Source: Forestry cost accounting 1995 – 2000 (WVS 1995 – 2000).

#### *Characteristics of the business processes*

Key processes – including biological production, timber harvesting, transport, marketing, sales, and planning and control – were studied in greater detail. In biological production it was especially noticed that in contrast to the traditional standard forest system strategy of even-aged forest, the strategy of uneven-aged forest was uniformly pursued in the entire forest district. The uniform acceptance of this scheme could well be challenged, because there is little confirmed knowledge about financial aspects of this strategy.

In technical production there is still room for rationalisation in respect to execution, planning and steering (Kraft 2000). In transport though, deficiencies were localised chiefly with the contractors and customers. Due to the absence of skills and know-how all forest enterprises lack professional timber marketing. The highly fractioned range is a serious handicap, not only impeding orientation towards the needs of important customers but also weakening the firm's position as supplier. Furthermore, it reduces flexibility and consequently increases the costs for supply, sales, distribution and administration. The forest managers chiefly use their experience and intuition as tools for planning and control. From a managerial point of view, the path of decision-making based on these soft factors is not reproducible and their impact on planned output cannot be checked.

#### *The human dimension*

Experience indicates that it is difficult to perform reengineering projects successfully without considering the views, opinions, expectations and doubts of the major stakeholders. Almost all persons involved agreed that the key weaknesses of the forest operation were the organisational structure based on small forest enterprises, inadequate customer orientation and the absence of marketing concepts and strategies. All affirmed that the majority of the problems could be solved by forming larger management units. Almost all interviewees said that they would actively support any restructuring and reorganising projects. Yet the obstacles against reorganisation which they mentioned indicated a number of doubts and fears among all partners, which in turn militates against the voiced openness and motivation towards change.

The situation analysis demonstrated that the chain of wood production can still be considerably rationalised. The main weaknesses relate to size of forest enterprises, numbers of staff, underutilised mechanisation potential, as well as the lack of marketing, efficient business organisation and supporting information technology.

#### **Goals and Competitive Strategies**

A meeting was held with representatives of the forest owners to determine what expectations and claims the forest owners have in respect to their forests. No clear picture about expectations emerged; the goals and competitive strategies for the new business situation reported had no general validity nor were they clearly defined. The aspirations of forest managers and the forest service were explored through interviews and workshops. All interviewees ultimately aimed for greatest possible competitiveness of wood production in order to safeguard long-term survival of the forest enterprises.

#### **SWOT ANALYSIS AS THE HINGE BETWEEN ANALYSIS AND SOLUTIONS**

By confronting the weaknesses and strengths with the opportunities and possible threats, corrective actions were elaborated in the SWOT-analysis. This 'analysis' does not really produce confirmed results but rather more or less arbitrarily deduced actions. Some of the strengths, weaknesses, opportunities and threats are reported in Figure 8. This Figure shows for instance that the strength 'readiness to change' –

voiced by all partners – can be used to seize the potential opportunities of mechanisation and to reduce the threats ‘Loss of competitiveness’ and ‘Loss of independence’. The corresponding actions are compiled in the fields of action ‘Timber harvesting’ and ‘Change management’ respectively.

		<b>Business Environment Analysis</b>	
		<b>Opportunities</b> <ul style="list-style-type: none"> <li>• Renewable, CO<sub>2</sub>-neutral resource</li> <li>• Potential for mechanisation</li> <li>• Availability of information technologies</li> </ul>	<b>Threats</b> <ul style="list-style-type: none"> <li>• Loss of authority</li> <li>• Loss of competitiveness</li> <li>• Scarcity of public means</li> <li>• Decreasing revenues from timber production</li> </ul>
<b>Enterprise Analysis</b>	<b>Strengths</b> Readiness to change Experience with cooperation Advantage of location	<i><b>‘Use strengths to profit from opportunities’</b></i>  <i>Organisation</i> <i>Biological production</i> <i>Timber harvesting</i> <i>Goals / Key figures</i> <i>Marketing / Sales</i>	<i><b>‘Use strengths to avert possible threats’</b></i>  <i>Organisation</i> <i>Generic value system</i> <i>Change management</i>
	<b>Weaknesses</b> Poor structure Excessive numbers of staff Inefficient procedures High costs	<i><b>‘Reduce weaknesses to profit from opportunities’</b></i>  <i>Organisation</i> <i>Biological production</i> <i>Timber harvesting</i> <i>Planning / Controlling</i> <i>Information</i> <i>Marketing / Sales</i>	<i><b>‘Reduce weaknesses to avert possible threats’</b></i>  <i>Organisation</i> <i>Goals / Key figures</i>

**Figure 8.** The linking SWOT analysis between the enterprise analysis and the business environment analysis

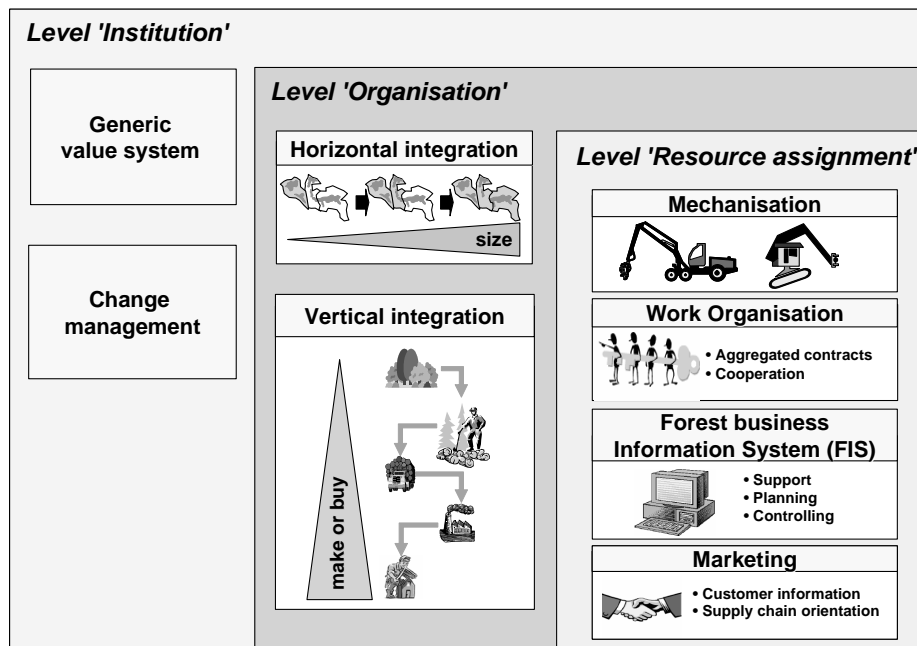
The elaborated actions are bundled in the following nine fields of action: ‘Organisation’, ‘Biological production’, ‘Timber harvesting’, ‘Goals / Key figures’, ‘Marketing / Sales’, ‘Information’, ‘Planning / Controlling’, ‘Generic value system’ and ‘Change management’. ‘Organisation’ proved to be of special importance, because it appears in all four strategic fields.

## IDENTIFICATION OF TREND-SETTING SOLUTIONS

Solutions were searched for on three action levels with different time ranges. The main focus was on the two levels 'Resource Assignment' and 'Organisation'. Methods of resolution were elaborated and rated for previously identified problems and fields of action together with the chain partners, particularly with the forest managers and the forest service. Figure 9 presents selected real methods of resolution and classifies them by their importance.

On the level 'Resource Assignment', actions are envisioned that will mainly improve efficiency. These measures could be realised relatively quickly (in months or a few years). The rationalisation potentials for instance offered by modern harvesting systems are not fully utilised in the district. Equally, the so-called block treatment could be further extended in harvesting. The latter calls for a concentration of harvesting operations in time and space in order to reduce the costs which accrue through displacement translocation of workforce and machinery

The level 'Organisation' includes strategic measures which improve effectiveness. Effectiveness indicates to what extent the output and the result of a process fulfils the expectations of the process owner or miscellaneous beneficiaries respectively. The main topics on this level are the changes and adaptations of the organisational structure such as cooperation among enterprises in respect to timber sales and machine-use which also play a major role in the case studied. Measures of this type enable greater efficiency in the use of production resources, although they may take some years to put into operation.

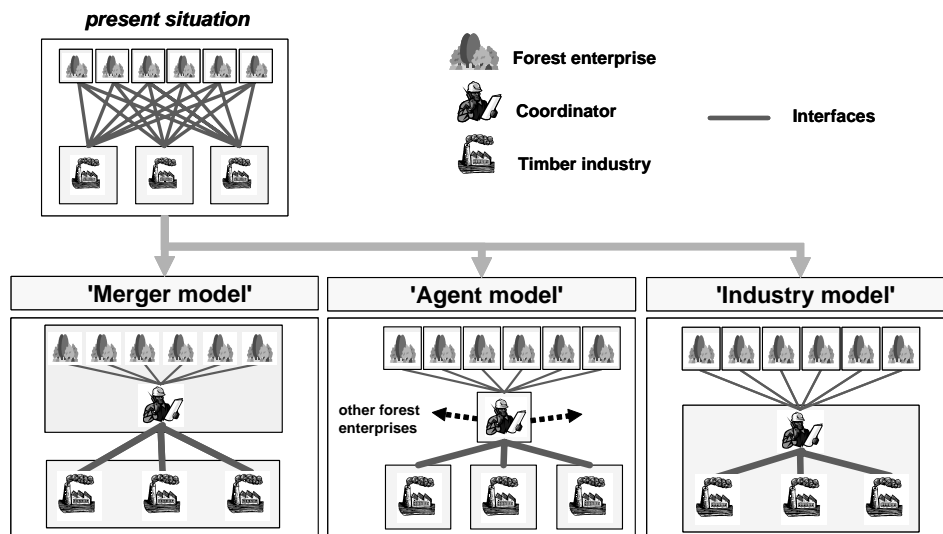


**Figure 9.** View of selected methods of resolution

The level 'Institution' is mainly made up by generic value systems and their gradual change. Normally it takes five to 15 years before changes materialise and it is not only the forest owners that take the corresponding decisions. 'Change management' and 'Generic value system' are the most important fields of action on the level 'Institution'. 'Change management' designs and supports the processes of change and reorganisation. Generic value systems are made up by social and political values, standards and legislation. The enterprise may have little impact on these elements, but must consider them in its reorganisation project.

The level 'Organisation' assumes increased importance in respect to improvement of competitive capacity. It implies the replacement of inefficient organisational structures within and between firms by better solutions. In the case study area, it is imperative to bundle the fragmented timber supply by amalgamating all timber sales.

Presently all business processes, except for transport from the forest to the sawmill, are managed by the forest enterprise. Horizontal and vertical integration are lacking and the forest ranges act as independent forest enterprises. Because all enterprises of the district sell virtually identical products to more or less the same customers, external interfaces in sales alone are legion. Figure 10 depicts the present situation against the three models under the aspect of the sales organisation. They differ mainly in the number of interfaces and in the location of the job compiling offers and demands for timber and working out their best fit. In the sketches only three of the actual 44 customers are shown.



**Figure 10.** Position of the sales agency and number of interfaces with three customers

### 'Merger model'

The forest enterprises of the district are horizontally amalgamated into one. Timber is centrally marketed and sold either at the forest road or on the stump. Managerial tasks are merged to functions and centralised and performed by the foresters. The

enterprise decides how core processes including timber harvesting are to be carried out. For economic reasons the enterprise should cover at least the area of the forest district or comprise an annual cut of 40,000 to 50,000 m<sup>3</sup>. In comparison to the current status the model does with considerably fewer external interfaces.

#### **‘Agent model’**

An agent and clearing house acts as a broker, respectively arranging and organising deals between vendor and vendee on a provisional basis. Ideally, the agent wholly markets the timber by stumpage, also organising the harvest, which is carried out by specialist contractors. The forest enterprise then focuses solely on the biological production. In this case the number of interfaces is greatly reduced. However, the model is only successful if a sufficient large number of enterprises cooperate with the agent.

#### **‘Industry model’**

This model involves the formation of a timber industry pool, i.e. one or several large converters build up their own centralised purchasing organisation, acquiring the timber as standing trees or as logs on the roadside dump. The timber is delivered to the pool plants or is resold to a third party. Chiefly forest contractors harvest the timber. In contrast to the ‘Agent model’ the purchasing organisation buys the timber and sells unsuitable assortments by itself. Again external interfaces are at least halved.

#### **Project Partners Evaluate the Models**

The models were evaluated upon a uniform raster with the present organisation serving as a reference. This raster was composed of 16 criteria, categorised into four groups according to their impact on the present situation: The interviewees were confronted with the followings 16 questions and statements and had to estimate whether the conditions in respect to the criteria were much worse (--), worse (-), equal (0), better (+) or much better (++) in the model than in the present situation.

##### *Safeguard of owners’ interests*

- To what extent will the economy of timber harvesting be improved?
- How much management authority has the forest owner to forego?
- Automatic safeguard of other forest functions besides timber production.

##### *Acceptability by the staff*

- Are the jobs of some staff members at risk?
- Will the remaining jobs be upgraded and be more secure?
- Acceptance of the new model – are improved job conditions readily evident for the staff?

##### *Fulfilment of customers’ needs (timber production)*

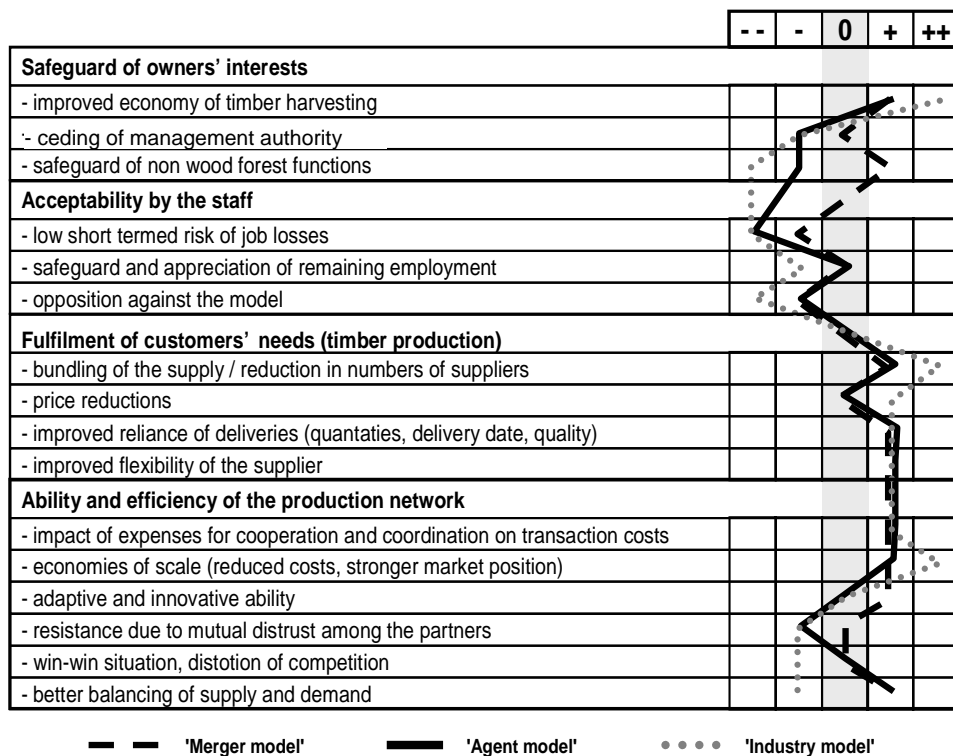
- Bundling of the supply / reduction in number of suppliers.
- Make cost reductions allowances for price reductions?
- Are deliveries reliable (quantities, delivery dates) and their grades more uniform in quality?
- Does the supplier gain in flexibility?



*Ability and efficiency of the production network*

- What impact do expenses have for cooperation and coordination on transaction costs along the entire timber production chain?
- Economies of scale / market position.
- In terms of adaptive and innovative ability, does the broader production basis enhance flexibility?
- Does the model enhance trust among the partners of the timber chain?
- Do more partners profit from the improved business environment (a win-win situation)?
- Does the broader production basis allow a better balancing of demand and supply?

The traverses in Figure 11 report the result of the evaluation by the foresters and the forest service.



**Figure 11.** Evaluation of the proposed model by the foresters and the forest service

Overall the 'Merger model' was rated best. Except for the criteria 'risk of job losses' and 'opposition by the staff', the model was expected to lead to a better outcome than the actual organisation. For the 'Agent model' a greater short-term risk of job losses was forecast as well as losses in management authority and in safeguard of social forest functions. Moreover, it was feared that mutual trust among the partners might abate. The 'Industry model' was expected to produce conflicting effects.

Substantial advantages in respect to economic aspects and to the fulfilment of customers' needs were opposed to serious losses in management authority, safeguard of social function and staff acceptance. Cutbacks in some aspects were even anticipated in respect to the ability and efficiency of the production network. The model was the least accepted of the three.

## FINAL REMARKS

Since completion of the study the recommended centralisation of the timber sales has been realised. Numerous forest owners, even from outside the district and state boundaries have floated a public company (named AAREHOLZ AG) that is charged to market the timber of all members and any third parties on commission. In the first six months of operation, it has marketed 28,000 m<sup>3</sup> of timber and the targeted 70,000 m<sup>3</sup> is expected to be achieved by the next financial year. The company is successfully expanding into pooling cuts and contracts. It has become apparent that centralised planning and steering of harvesting operations is an important factor of success for amalgamated sales. It is foreseeable that the partners will eventually merge to one enterprise. Already in its present intermediate stage AAREHOLZ AG has stimulated a number of similar initiatives.

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